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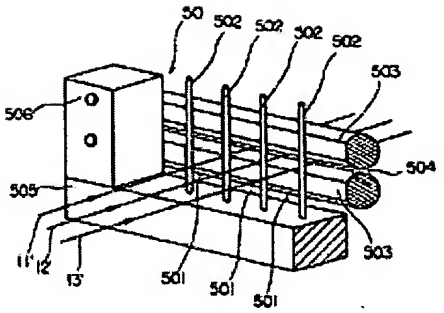
54. TITLE OF INVENTION: Filament Winding Forming Method

57. ABSTRACT

CONSTITUTION: A plurality of resin-impregnated rovings of fibers 11', 12', 13' is passed at least one by one in a parallel state through the gaps 501 and slit 504 of a traverse eye 50 consisting of comb-shaped pins 502 having a plurality of gaps 501 and a pair of slit bars 503 disposed orthogonal to and near the pins 502 in this sequence, and converge in a tape shape. This is helically wound in layers on a mandrel, laminated, and the resin is hardened and it is removed from the mold.

EFFECT: Even when the number of rovings of fibers increases and makes a wide tape shape, the respective rovings of fibers are converged by the gaps and slits of the traverse eye and do not interfere with one another, and slackness with nonuniform tension does not occur, and nap and breaks caused by slackness do not occur. Also, overall [the rovings of fibers] are converged to be flat and thin and wide, and the pay-out point on the mandrel is kept constant. Therefore it is possible to obtain a fiber reinforced resin formed body with good quality such as precise thickness, etc., and to obtain it with good productivity.



CLAIMS

Claim 1: A filament winding forming method wherein a plurality of rovings of fibers is impregnated with resin, and this plurality of resin impregnated rovings of fibers is passed at least one by one in a parallel state through the gaps and slit of a traverse eye consisting of comb-shaped pins having a plurality of gaps and a pair of slit bars provided orthogonal to and near these pins in this sequence and [the rovings] are converged in a tape shape; this converged tape-shaped resin impregnated rovings of fibers is wound in layers on the outer circumference of a mandrel, and the resin is hardened and it is removed from the mold.

DETAILED DESCRIPTION OF THE INVENTION

[0001]

Field of Industrial Utilization

The present invention pertains to a filament winding forming method for obtaining various types of fiber reinforced resin formed bodies, such as a tubular shape, container shape, etc.

[0002]

Prior Art

A fiber reinforced resin formed body made by the filament winding method is generally manufactured by impregnating a plurality of rovings of fibers with resin, passing the plurality of resin impregnated rovings of fibers through a doughnut-shaped traverse eye in a parallel state and converging them in a tape shape, winding and laminating these converged tape-shaped resin impregnated rovings of fibers on the outer circumference of a mandrel, hardening the resin and removing it from the mold. This sort of manufacturing technique is widely known.

[0003]

Problems the Invention Is to Solve

In this sort of conventional filament winding forming method, if the transport speed of the rovings of fibers is increased in order to improve productivity, impregnation of the fibers by the resin becomes bad, and nap and breaks occur in the fibers, and it is not possible to stably manufacture a formed body with good quality.

[0004]

Also, if the number of rovings of fibers is increased in order to improve productivity and a wide tube-shaped resin impregnated roving of fibers is formed, the multiple rovings of fibers interfere with one another and become nonuniform, and

slackness occurs in some of the rovings of fibers, and nap and breaks occur in the fibers because of this slackness, and in this case too it is not possible to stably manufacture a formed body with good quality. Moreover, when passing through the doughnut-shaped traverse eye, the plurality of rovings of fibers approaches the center part, and the converged tape-shaped resin impregnated roving of fibers becomes thick, and the thickness of the formed body cannot be precisely adjusted.

[0005]

The present invention is one that solves the above-described problems. Its object is to provide a filament winding forming method that can stably obtain a good-quality fiber reinforced resin formed body with good productivity.

[0006]

Means for Solving the Problems

The inventive filament winding forming method is characterized in that a plurality of rovings of fibers is impregnated with resin, and this plurality of resin impregnated rovings of fibers is passed at least one by one in a parallel state through the gaps and slit of a traverse eye consisting of comb-shaped pins having a plurality of gaps and a pair of slit bars provided orthogonal to and near these pins in this sequence and [the rovings] are converged in a tape shape; this converged tape-shaped resin impregnated rovings of fibers is wound in layers on the outer circumference of a mandrel, and the resin is hardened and it is removed from the mold.

[0007]

Below, the present invention shall be described in detail with reference to drawings. FIG. 1 is a partial cutaway oblique view showing the main part of the present invention, and FIG. 2 is an explanatory drawing showing the general outline of the present invention. In FIG. 2, a plurality of rovings of fibers 11, 12, 13 respectively pass through guide rolls 21, 22, 23, and pass by fiber transport roll 31 and resin impregnation roll 40 and fiber transport roll 32 in sequence. Glass fiber rovings or carbon fiber rovings, etc. are generally used as the plurality of rovings of fibers 11, 12, 13. The plurality of rovings of fibers 11, 12, 13 is shown as three for convenience, but in practice dozens are used.

[0008]

Generally, a resin solution such as a thermosetting unsaturated polyester resin solution or epoxy rein solution, etc. is put in an impregnation bath 41, and when the plurality of rovings of fibers 11, 12, 13 makes passing contact with the resin impregnation roll 40 of the impregnation bath 41, a suitable amount of the resin solution impregnates the plurality of rovings of fibers 11, 12, 13 due to this resin impregnation roll 40. The plurality of resin impregnated rovings of fibers 11', 12', 13' that was formed in this manner passes through the traverse eye 50 in a parallel state, and is converged to a tape shape here.

[0009]

The above-described traverse eye 50 consists of comb-shaped pins 502 having a plurality of gaps 501 and a pair of slit bars 503 disposed orthogonal to and near the pins 502 as shown in FIG. 1. A plurality of gaps 501 is formed by the plurality of pins 502, and a slit 504 is horizontally formed by the pair of slit bars 503. Furthermore, one end of the plurality of pins 502 is vertically inserted and fixed in a pin mounting stand 505, and both ends of the pair of slit bars 503 are screwed to a bar mounting stand 506. In

addition, both ends of the pin mounting stand 505 and the bar mounting stand 506 are screwed so that the comb-shaped pins 502 and the pair of slit bars 503 are near and orthogonal. This constitutes a traverse eye 50 in which the comb-shaped pins 502 and the pair of slit bars 503 are integrated.

[0010]

Usually, something round and column-shaped is used for the pins 502 and slit bars 503. Also, the diameter of the pins 502 is generally 2~8 mm, the gaps 501 are 3~20 mm, the diameter of the slit bars 503 is 2~20 mm, and the slit is often 2~10 mm. These dimensions are appropriately determined according to the yarn count of the roving of fibers. It is preferred that the pins 502 and the slit bars 503 be as near as possible. Furthermore, this is omitted from the drawing, but the traverse eye 50 is mounted on a traverse stand and is constituted so that it can move vertically, laterally, and forward/backward; in addition, it is constituted so that turn clockwise/counterclockwise relative to the center axis.

[0011]

As shown in FIG. 1, the plurality of resin impregnated rovings of fibers 11', 12', 13' passes through each gap 501 and the slit 504 of the traverse eye in a parallel state in this sequence, and are converged to a tape shape here. Then, as shown in FIG. 2, the converged tape-shaped resin impregnated roving of fibers 60 is helically wound in a predetermined pattern on the outer circumference of a mandrel 70 that is T-shaped, for example, and laminated to the desired thickness, and is subsequently put in a heating furnace, etc. and heated and hardened, and finally is removed from the mandrel 70. Furthermore, the mandrel 70 is constituted so that it can rotate on the axis of its main tubular portion. Thus a T-type fiber reinforced resin tube joint can be manufactured. Furthermore, by varying the shape of the mandrel 70 it is possible to manufacture fiber reinforced resin formed bodies of various shapes, such as an elbow tube joint, a socket tube joint, or a long pipe, container, etc.

[0012]

Operation

In the inventive method, a plurality of rovings of fibers is impregnated with resin, and this plurality of resin impregnated rovings of fibers is passed at least one by one in a parallel state through the gaps and slit of a traverse eye consisting of comb-shaped pins having a plurality of gaps and a pair of slit bars provided orthogonal to and near these pins in this sequence; when this plurality of resin impregnated rovings of fibers passes through the gaps and slit of the traverse eye they are converged by the above-described gaps and slit and do not interfere with one another and emerge smoothly in a tube shape and are converged. Therefore it is difficult for nonuniform tension to occur in the plurality of resin impregnated rovings of fibers, the occurrence of slackness is prevented, and nap and breaks caused by slackness do not occur.

[0013]

Also, it is hard for nonuniform tension to occur in the plurality of rovings of fibers passing through the gaps and slit of the traverse eye in this manner, so the number of rovings of fibers can be increased, and this sort of plurality of rovings of fibers is converged to a flat and thin wide tape shape overall by the action of the traverse eye's gaps and slit, and the efficiency of winding on the mandrel increases.

[0014]

In addition, for example, as when manufacturing a product that is not axially symmetrical, such as a T-type tube joint, etc., even if a clockwise/counterclockwise turning motion is applied the traverse eye itself, the plurality of rovings of fibers tracks the movement of the turning motion, etc. well and the pay-out point on the mandrel is kept constant.

[0015]

Embodiment

Shown below are an embodiment of the present invention and a comparative example.

First, as shown in FIG. 1 and FIG. 2, 10 glass fiber rovings (yarn count 2230 g/km) were made parallel and passed by a resin impregnation roll and fiber transport roll, forming 10 resin impregnated fiber rovings impregnated with a thermosetting epoxy resin solution. The thermosetting epoxy resin solution consisted of 100 weight-parts epoxy resin (LY-556: Ciba-Geigy Japan) and 90 weight-parts hardening agent (HY-917: Ciba-Geigy Japan) and 0.5 weight-parts accelerator (DY-070: Ciba-Geigy Japan). Also, the glass fiber roving content was about 60 volume%.

[0016]

Next, these 10 resin impregnated fiber rovings were respectively passed, in a parallel state, one by one through the gaps and slit of a traverse eye consisting of comb-shaped pins having 10 gaps and a pair of slit bars provided orthogonal to and near (adjacent to) these pins in this sequence, and converged to a tape shape about 44 mm wide. Each pin was column-shaped with a diameter of 3 mm and length of 30 mm; the pair of slit bars was column-shaped and flat at one part, with a diameter of 12 mm and length of 120 mm; the slit was set at 3 mm parallel.

[0017]

This converged tape-shaped resin impregnated fiber roving was helically wound and laminated on the outer circumference of a T-shaped mandrel that could be assembled and disassembled; it was wound in a predetermined pattern to produce a thickness of 5 mm in the main tube potion and branch tube portion, and a thickness of 10 mm in the portion where the main tube portion and the branch tube portion joined. This was heated and hardened at 130°C for two hours to manufacture a T-type tube joint. Furthermore, the length of the main tube portion was set at 700 mm, the length of the branch tube portion was set at 400 mm, and the tube inner diameter was set at 165 mm.

[0018]

In this case, it was possible to stably wind the mandrel in about 30 minutes without nap or breaks occurring in the glass fiber roving. Also, the thickness of the main tube portion and the branch tube portion of the resulting T-type tube joint was 5.5 ±1 mm, and the thickness of the joined portion between the main tube portion and the branch portion was 11.5 ±1 mm. This T-type tube joint did not break down at water pressure of 40 kg/cm^2, and maintained adequate strength.

Comparative Example

A conventional doughnut-shaped traverse eye with linear diameter 6 mm and inner diameter 40 mm was used as the traverse eye in this embodiment. Otherwise, things were the same as in the embodiment.

[0019]

In this case, breaks occurred twice in the glass fiber rovings. It was not possible to speed up the transport speed for two reasons – transporting the glass fiber rovings was unstable and the thickness was thick to maintain the minimum thickness – so winding required about 50 minutes. Also, the thickness of the main tube portion and the branch tube portion of the resulting T-type tube joint was 7 ±3 mm, and the thickness of the junction between the main tube portion and the branch portion was 16.5 ±5 mm; there was much randomness in the thickness.

[0020]

Effect of the Invention

As described above, according to the inventive filament winding forming method, even if the number of rovings of fibers is increased or a wide tape shape is made, the tension of the plurality of rovings of fibers does not become nonuniform and slackness does not occur, and nap and breaks caused by slackness do not occur. Therefore it is possible to stably obtain a good-quality fiber reinforced resin formed body with good productivity.

[0021]

Also, according to the inventive method, by increasing the number of rovings of fibers and making a wide tape shape it is possible to form this relatively thinly, so the thickness of a fiber reinforced resin formed body can be precisely adjusted. In particular, as when manufacturing a product that is not axially symmetrical, such as a T-type tube joint, etc., even if a clockwise/counterclockwise turning motion is applied the traverse eye itself, the pay-out point on the mandrel is kept constant, so the inventive method is suitable for manufacturing an axially symmetrical product, of course, and for manufacturing a product that is not axially symmetrical. It has this advantage in particular.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1: A partial cutaway oblique view showing the main part of the present invention.

FIG. 2: An explanatory drawing showing the general outline of the present invention.

EXPLANATION OF CODES:

11	Rovings of fibers
12	Rovings of fibers
13	Rovings of fibers
11'	Resin impregnated rovings of fibers
12'	Resin impregnated rovings of fibers
13'	Resin impregnated rovings of fibers
40	Resin impregnation roll
50	Traverse eye
501	Plurality of pin gaps
502	Plurality of pins
503	Pair of slit bars
504	Slit bar slit

60 Tape-shaped resin impregnated rovings of fibers
70 Mandrel

FIG. 1

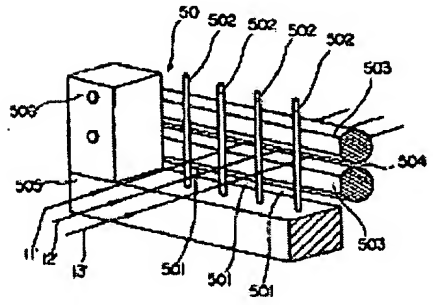
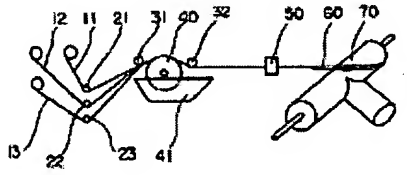


FIG. 2



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Certificate of Accuracy

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April 17, 2006